MINMAX®

MKZI20 Series

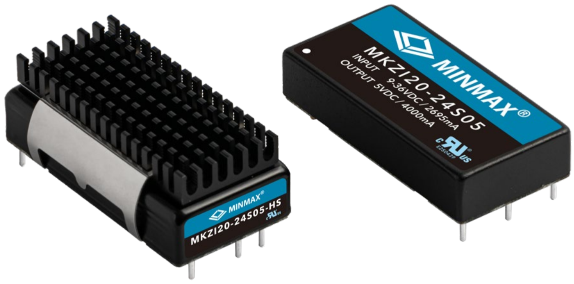
Electric Characteristic Note

MKZI20 Series EC Note

DC-DC CONVERTER 20W, Reinforced Insulation, Railway Certified

Features

- ►**Industrial Standard 2"x1" Package**
- ►**Ultra-wide Input Range 9-36VDC, 18-75VDC, 40-160VDC**
- ►**I/O Isolation 3000VAC with Reinforced Insulation**
- ►**Operating Ambient Temp. Range -40℃ to +88.5℃**
- ►**No Min. Load Requirement**
- ►**Under-voltage, Overload/Voltage and Short Circuit Protection**
- ►**Remote On/Off, Output Voltage Trim**
- ►**Conducted EMI EN 55032/11 Class A Approved**
- ►**Vibration and Shock/Bump Test EN 61373 Approved**
- ►**Cooling, Dry & Damp Heat Test IEC/EN 60068-2-1, 2, 30 Approved**
- ►**Railway EMC Standard EN 50121-3-2 Approved**
- ►**Railway Certified EN 50155 (IEC60571) Approved**
- ►**Fire Protection Test EN 45545-2 Approved**
- ►**UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE Marking**



Applications

- ►Distributed power architectures
- ►Workstations
- ►Computer equipment
- ►Communications equipment

Product Overview

The MINMAX MKZI20 series is a range of high performance 20W isolated DC-DC converter within encapsulated 2"x1" package which specifically design for railway applications. There are 18 models available for the railway system of multi-input voltage range by 24(9~36)VDC、48(18~75)VDC、72/110(40~160)VDC and fixed output voltage regulation. Further features include under-voltage, overload, over voltage, short circuit protection, remote ON/OFF, output voltage trim and conducted EMI EN 55032/11 Class A as well.

MKZI20 series conform to vibration and thermal shock/bump test EN 61373, cooling, dry and damp heat test IEC/EN 60068-2-1,2,30 and railway EMC standard EN 50121-3-2 and complies also with Railway Certification EN 50155 (IEC 60571). MKZI20 series offer an highly reliable solution for critical applications in railway systems, battery-powered equipment, measure instrumentation and many critical applications.

Table of contents

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Over Voltage Protection	Max. capacitive Load	Efficiency (typ.)
			Max.	@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	VDC	µF	%
MKZI20-24S05	24 (9 ~ 36)	5	4000	958	25	6.2	6800	87
MKZI20-24S12		12	1670	960		15	1200	87
MKZI20-24S15		15	1330	955		18	750	87
MKZI20-24S24		24	833	957		30	300	87
MKZI20-24D12		±12	±833	969		±15	600#	86
MKZI20-24D15		±15	±667	969		±18	380#	86
MKZI20-48S05	48 (18 ~ 75)	5	4000	479	15	6.2	6800	87
MKZI20-48S12		12	1670	474		15	1200	88
MKZI20-48S15		15	1330	472		18	750	88
MKZI20-48S24		24	833	473		30	300	88
MKZI20-48D12		±12	±833	479		±15	600#	87
MKZI20-48D15		±15	±667	479		±18	380#	87
MKZI20-110S05	110 (40 ~ 160)	5	4000	216	10	6.2	6800	84
MKZI20-110S12		12	1670	212		15	1200	86
MKZI20-110S15		15	1330	211		18	750	86
MKZI20-110S24		24	833	211		30	300	86
MKZI20-110D12		±12	±833	211		±15	600#	86
MKZI20-110D15		±15	±667	212		±18	380#	86

For each output

Input Specifications

Parameter	Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (100ms. max)	24V Input Models	-0.7	---	50	VDC
	48V Input Models	-0.7	---	100	
	110V Input Models	-0.7	---	170	
Start-Up Threshold Voltage	24V Input Models	---	---	9	
	48V Input Models	---	---	18	
	110V Input Models	---	---	40	
Under Voltage Shutdown	24V Input Models	---	7.5	---	
	48V Input Models	---	16	---	
	110V Input Models	---	37	---	
Start Up Time	All Models	---	30	50	mS
Input Filter		Internal Pi Type			

Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	3.5V ~ 12V or Open Circuit				
Converter Off	0V ~ 1.2V or Short Circuit				
Control Input Current (on)	Vctrl = 5.0V	---	0.5	---	mA
Control Input Current (off)	Vctrl = 0V	---	-0.5	---	mA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	---	2.5	---	mA

<table>
<tr><th colspan="8">Output Specifications</th></tr>
<tr><th>Parameter</th><th colspan="3">Conditions / Model</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>Output Voltage Setting Accuracy</td><td colspan="3"></td><td>---</td><td>---</td><td>±1.0</td><td>%Vnom.</td></tr>
<tr><td>Output Voltage Balance</td><td colspan="3">Dual Output, Balanced Loads</td><td>---</td><td>---</td><td>±2.0</td><td>%</td></tr>
<tr><td>Line Regulation</td><td colspan="3">Vin=Min. to Max. @ Full Load</td><td>---</td><td>---</td><td>±0.2</td><td>%</td></tr>
<tr><td rowspan="2">Load Regulation</td><td colspan="2" rowspan="2">Io=0% to 100%</td><td>Single Output</td><td>---</td><td>---</td><td>±0.5</td><td>%</td></tr>
<tr><td>Dual Output</td><td>---</td><td>---</td><td>±1.0</td><td>%</td></tr>
<tr><td>Minimum Load</td><td colspan="7">No minimum Load Requirement</td></tr>
<tr><td rowspan="3">Ripple & Noise</td><td rowspan="3">0-20 MHz Bandwidth</td><td>5Vo</td><td rowspan="2">Measured with a 10μF/25V MLCC</td><td>---</td><td>50</td><td>---</td><td>mV P-P</td></tr>
<tr><td>12Vo,15Vo, ±12Vo, ±15Vo</td><td>---</td><td>100</td><td>---</td><td>mV P-P</td></tr>
<tr><td>24Vo</td><td>Measured with a 4.7μF/50V MLCC</td><td>---</td><td>150</td><td>---</td><td>mV P-P</td></tr>
<tr><td>Transient Recovery Time</td><td colspan="3" rowspan="2">25% Load Step Change (2)</td><td>---</td><td>---</td><td>300</td><td>μsec</td></tr>
<tr><td>Transient Response Deviation</td><td>---</td><td>±3</td><td>±5</td><td>%</td></tr>
<tr><td>Temperature Coefficient</td><td colspan="3"></td><td>---</td><td>---</td><td>±0.02</td><td>%/℃</td></tr>
<tr><td>Trim Up / Down Range (See Page 8)</td><td colspan="3">% of Nominal Output Voltage</td><td>---</td><td>---</td><td>±10</td><td>%</td></tr>
<tr><td>Over Load Protection</td><td colspan="3">Hiccup</td><td>---</td><td>150</td><td>---</td><td>%</td></tr>
<tr><td>Short Circuit Protection</td><td colspan="7">Continuous, Automatic Recovery (Hiccup Mode 0.3Hz typ. / 0.5Hz max.)</td></tr>
</table>

<table>
<tr><th colspan="6">General Specifications</th></tr>
<tr><th>Parameter</th><th>Conditions</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>I/O Isolation Voltage</td><td>Reinforced Insulation, Rated For 60 Seconds</td><td>3000</td><td>---</td><td>---</td><td>VAC</td></tr>
<tr><td>Isolation Voltage Input/Output to case</td><td>Rated For 60 Seconds</td><td>1500</td><td>---</td><td>---</td><td>VAC</td></tr>
<tr><td>I/O Isolation Resistance</td><td>500 VDC</td><td>1000</td><td>---</td><td>---</td><td>MΩ</td></tr>
<tr><td>I/O Isolation Capacitance</td><td>100kHz, 1V</td><td>---</td><td>1500</td><td>---</td><td>pF</td></tr>
<tr><td>Switching Frequency</td><td></td><td>260</td><td>280</td><td>310</td><td>kHz</td></tr>
<tr><td>MTBF(calculated)</td><td>MIL-HDBK-217F@25℃ Full Load, Ground Benign</td><td>665,100</td><td>---</td><td>---</td><td>Hours</td></tr>
<tr><td rowspan="2">Safety Approval</td><td colspan="5">UL/cUL 60950-1 recognition(UL certificate), IEC/EN 60950-1(CB-report), EN 50155, IEC 60571</td></tr>
<tr><td colspan="5">UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)</td></tr>
</table>

<table>
<tr><th colspan="5">EMC Specifications</th></tr>
<tr><th>Parameter</th><th colspan="3">Standards & Level</th><th>Performance</th></tr>
<tr><td>General</td><td colspan="4">Compliance with EN 50121-3-2 Railway Applications</td></tr>
<tr><td rowspan="2">EMI(5)</td><td>Conduction</td><td rowspan="2">EN 55032/11</td><td>Without external components</td><td rowspan="2">Class A</td></tr>
<tr><td>Radiation</td><td>With external components</td></tr>
<tr><td rowspan="7">EMS(5)</td><td colspan="4">EN 55024</td></tr>
<tr><td>ESD</td><td colspan="2">EN 61000-4-2 Air ± 8kV, Contact ± 6kV</td><td>A</td></tr>
<tr><td>Radiated immunity</td><td colspan="2">EN 61000-4-3 10V/m</td><td>A</td></tr>
<tr><td>Fast transient</td><td colspan="2">EN 61000-4-4 ±2kV</td><td>A</td></tr>
<tr><td>Surge</td><td colspan="2">EN 61000-4-5 ±2kV</td><td>A</td></tr>
<tr><td>Conducted immunity</td><td colspan="2">EN 61000-4-6 10Vrms</td><td>A</td></tr>
<tr><td>PFMF</td><td colspan="2">EN 61000-4-8 100A/m, 1000A/m For 1 Second</td><td>A</td></tr>
</table>

Environmental Specifications

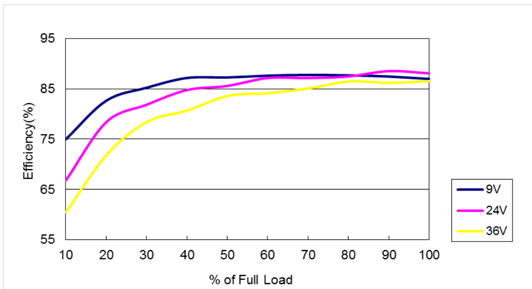
Parameter	Conditions / Model	Min.	Typ.	Max.		Unit
				without Heatsink	with Heatsink	
Operating Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MKZI20-48S12, MKZI20-48S15, MKZI20-48S24	-40	---	72	78	℃
	MKZI20-24S05, MKZI20-24S12, MKZI20-24S15 MKZI20-24S24, MKZI20-48S05, MKZI20-48D12 MKZI20-48D15		---	69	76	
	MKZI20-24D12, MKZI20-24D15, MKZI20-110S12 MKZI20-110S15, MKZI20-110S24, MKZI20-110D12 MKZI20-110D15		---	66	73	
	MKZI20-110S05		---	59	68	
Thermal Impedance	20LFM Convection without Heatsink	12.1	---	---		℃/W
	20LFM Convection with Heatsink	9.8	---	---		℃/W
	100LFM Convection without Heatsink	9.2	---	---		℃/W
	100LFM Convection with Heatsink	5.4	---	---		℃/W
	200LFM Convection without Heatsink	7.8	---	---		℃/W
	200LFM Convection with Heatsink	4.5	---	---		℃/W
	400LFM Convection without Heatsink	5.2	---	---		℃/W
	400LFM Convection with Heatsink	3.0	---	---		℃/W
Case Temperature		---	---	+105		℃
Over Temperature Protection (Case)		---	+115	---		℃
Storage Temperature Range		-50	---	+125		℃
Cooling Test	Compliance to IEC/EN60068-2-1					
Dry Heat	Compliance to IEC/EN60068-2-2					
Damp Heat	Compliance to IEC/EN60068-2-30					
Shock & Vibration Test	Compliance to IEC/EN 61373					
Operating Humidity (non condensing)		---	---	95		% rel. H
RFI	Six-Sided Shielded, Metal Case					
Lead Temperature (1.5mm from case for 10Sec.)		---	---	260		℃

Notes

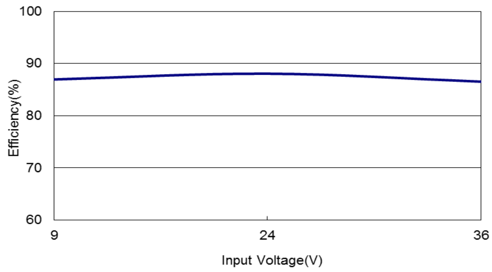
1. Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2. Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3. We recommend to protect the converter by a slow blow fuse in the input supply line.
4. Other input and output voltage may be available, please contact MINMAX.
5. The external components might be required to meet EMI/EMS standard for some of test items. Please contact MINMAX for the solution in detail.
6. Specifications are subject to change without notice.

Characteristic Curves

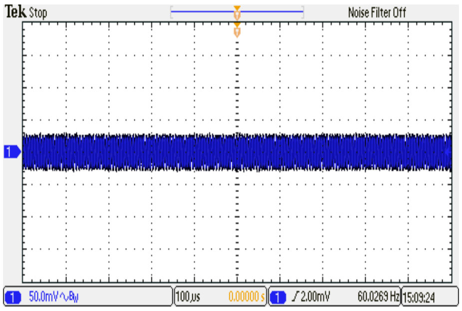
All test conditions are at 25℃ The figures are identical for MKZI20-24S05



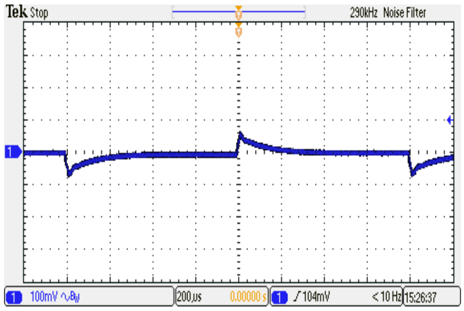
Efficiency Versus Output Current



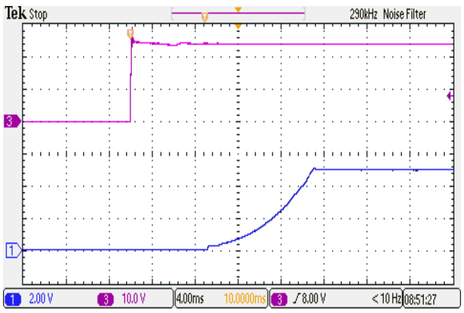
Efficiency Versus Input Voltage
Full Load



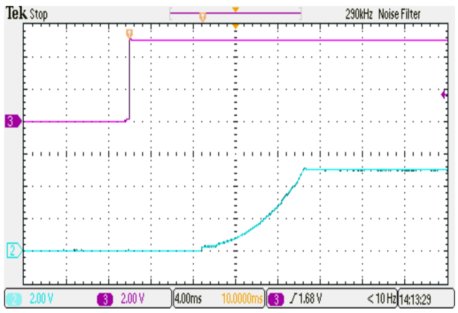
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



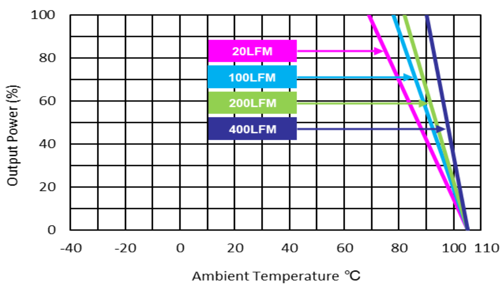
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



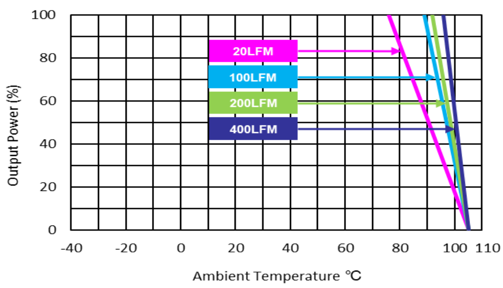
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



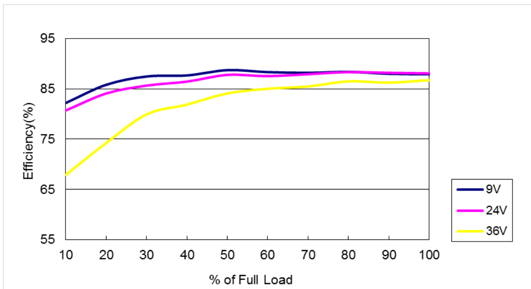
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



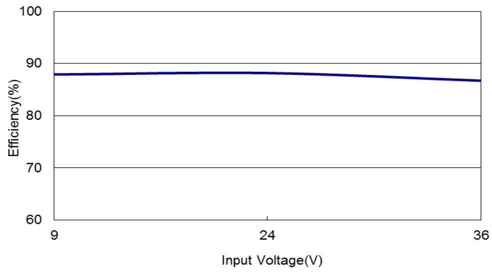
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

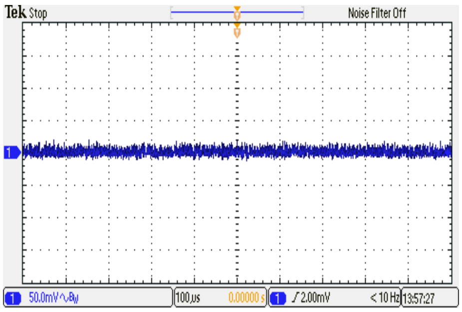
All test conditions are at 25℃ The figures are identical for MKZI20-24S12



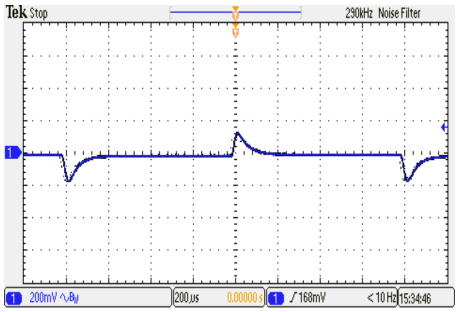
Efficiency Versus Output Current



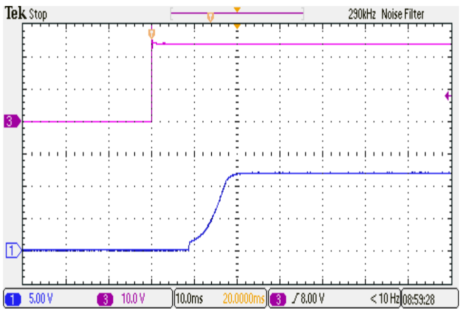
Efficiency Versus Input Voltage
Full Load



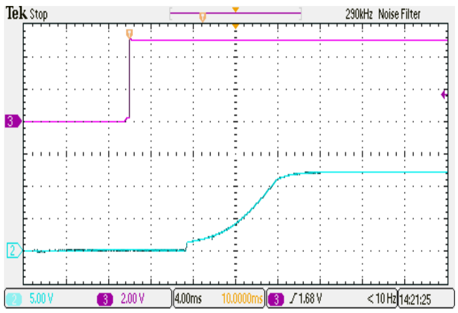
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



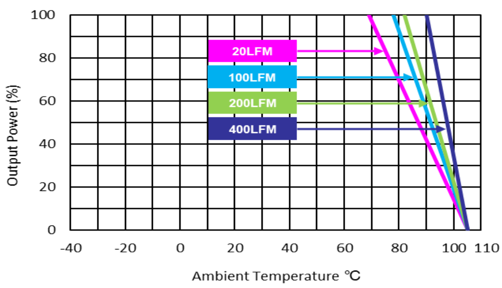
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



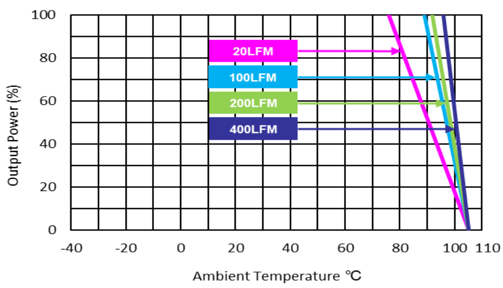
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



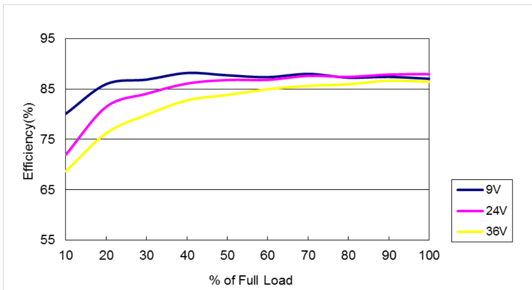
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



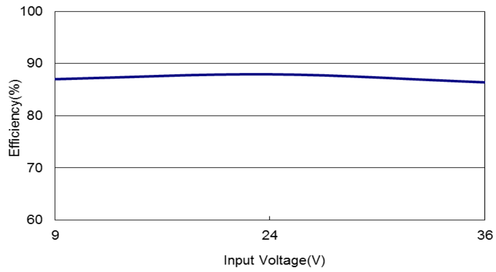
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

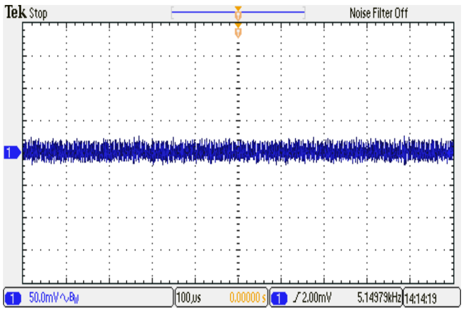
All test conditions are at 25℃ The figures are identical for MKZI20-24S15



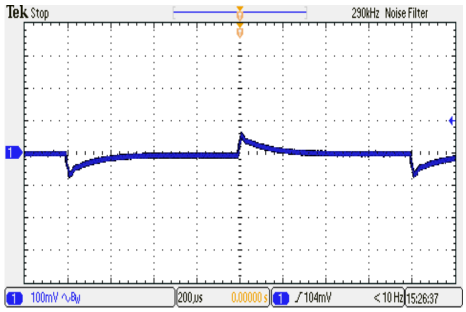
Efficiency Versus Output Current



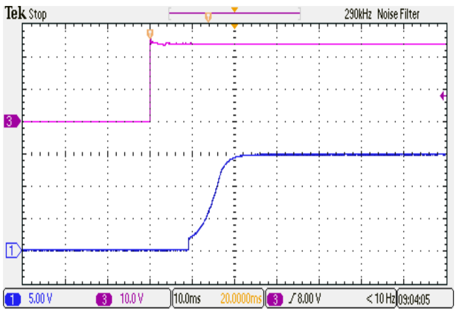
Efficiency Versus Input Voltage
Full Load



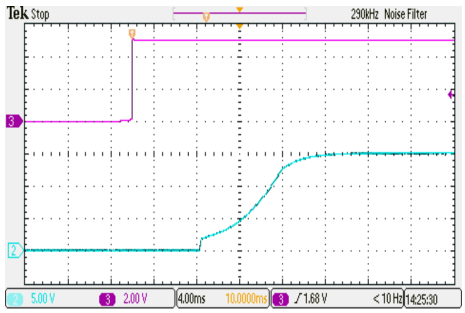
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



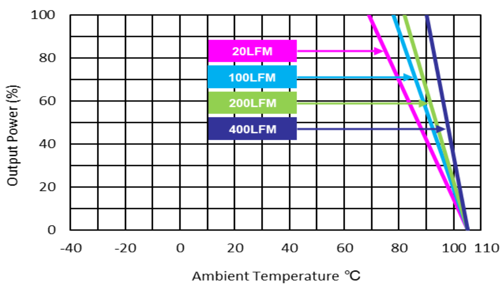
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



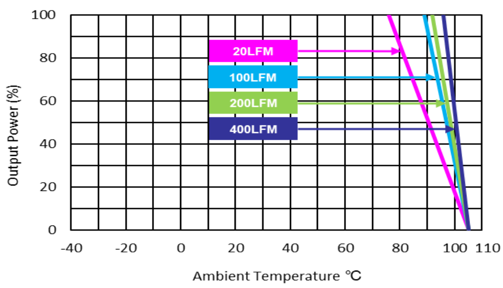
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



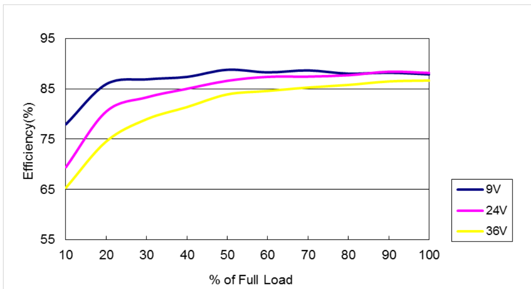
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



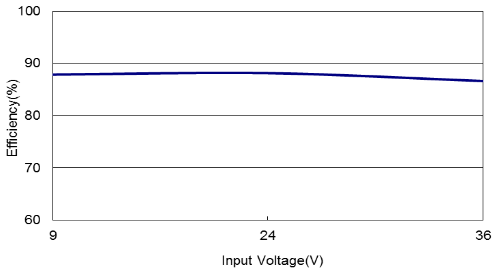
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

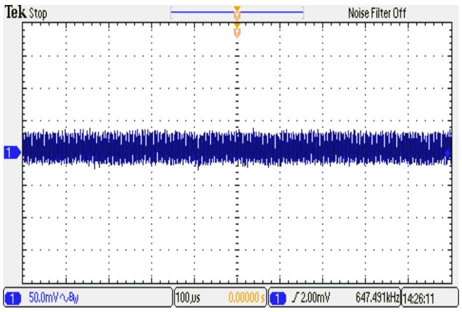
All test conditions are at 25℃ The figures are identical for MKZI20-24S24



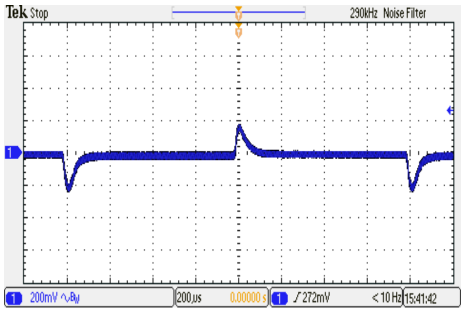
Efficiency Versus Output Current



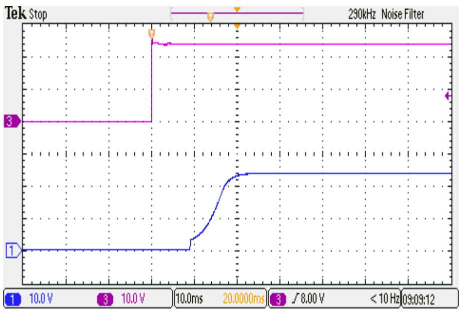
Efficiency Versus Input Voltage
Full Load



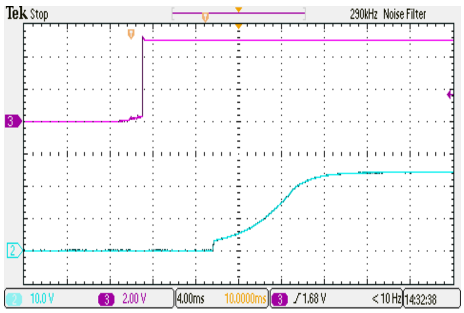
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



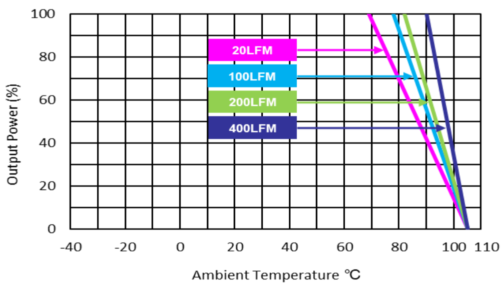
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



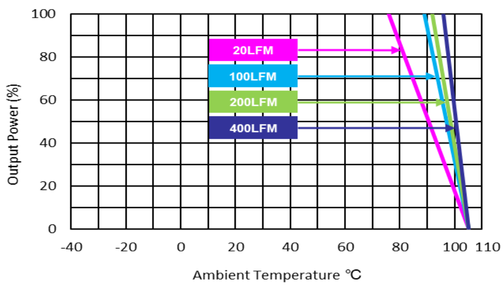
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



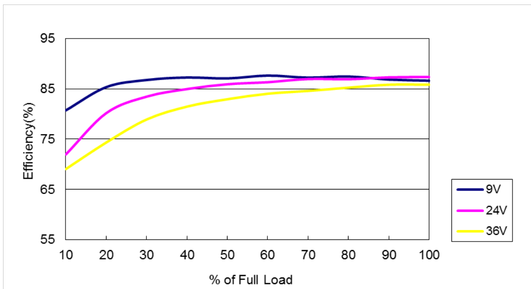
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



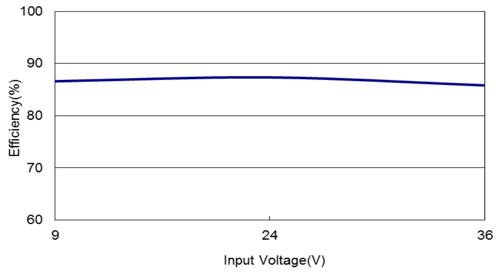
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

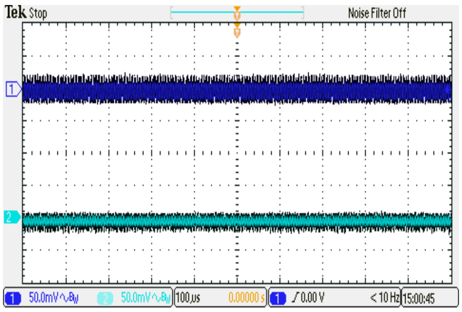
All test conditions are at 25℃ The figures are identical for MKZI20-24D12



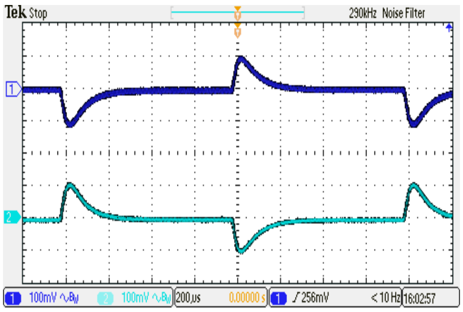
Efficiency Versus Output Current



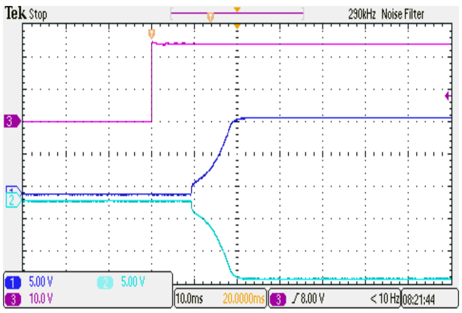
Efficiency Versus Input Voltage
Full Load



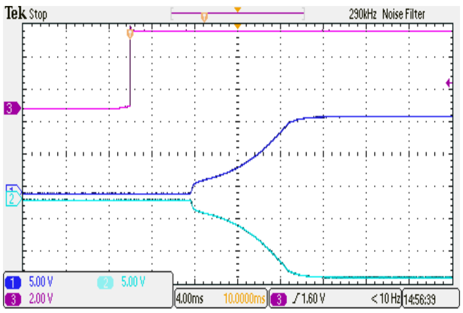
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



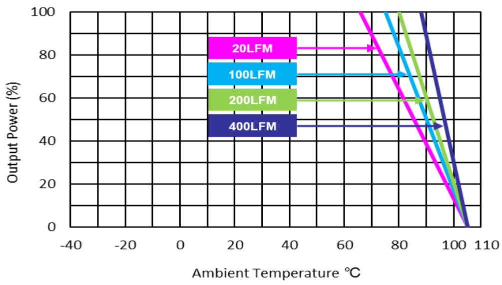
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



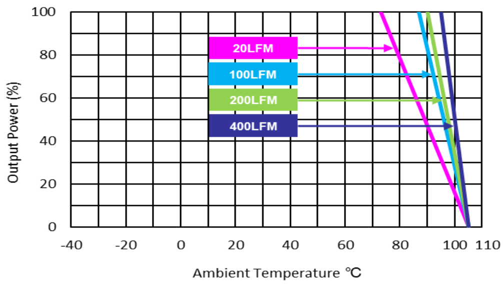
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



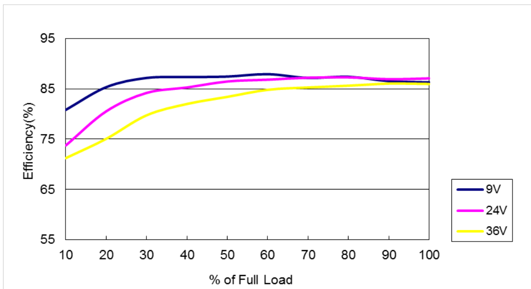
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



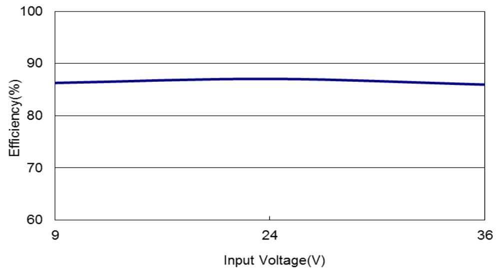
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

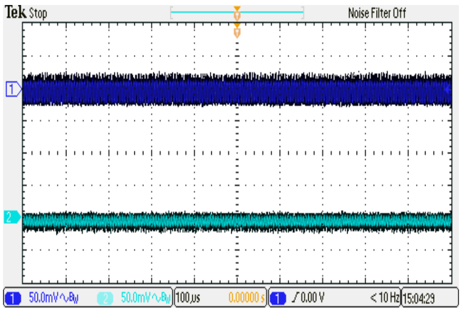
All test conditions are at 25℃ The figures are identical for MKZI20-24D15



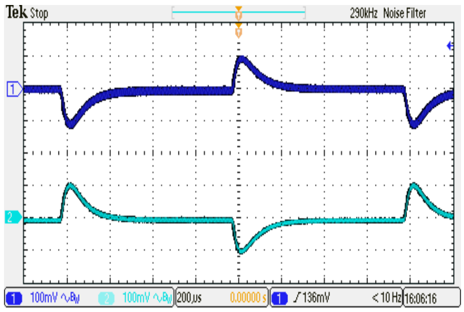
Efficiency Versus Output Current



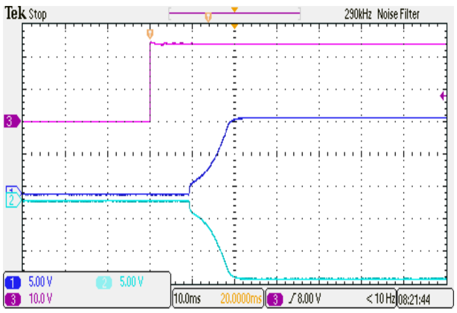
Efficiency Versus Input Voltage
Full Load



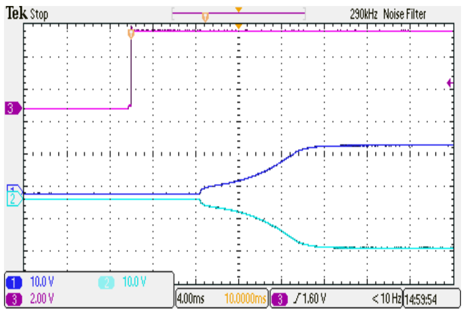
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



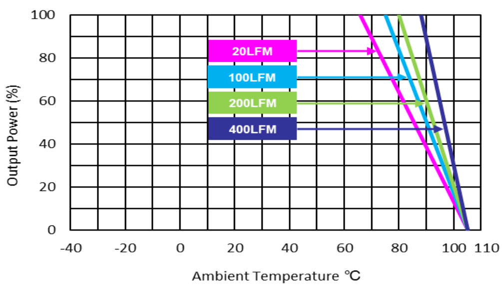
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



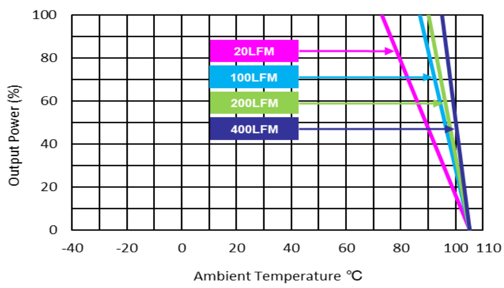
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



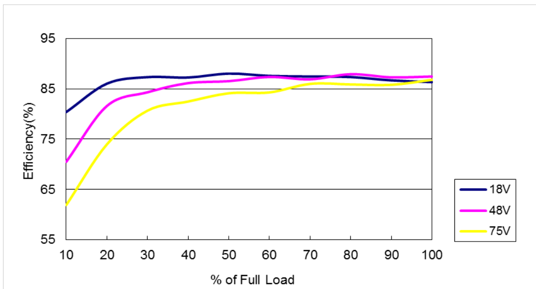
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



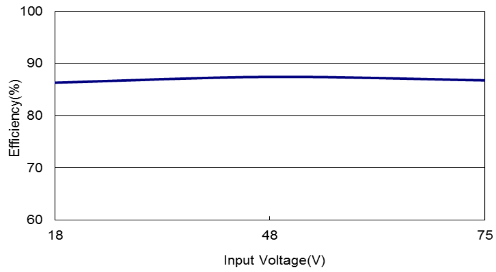
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

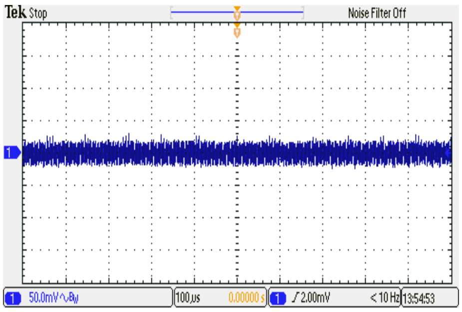
All test conditions are at 25℃ The figures are identical for MKZI20-48S05



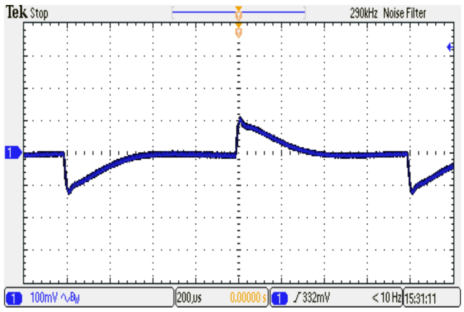
Efficiency Versus Output Current



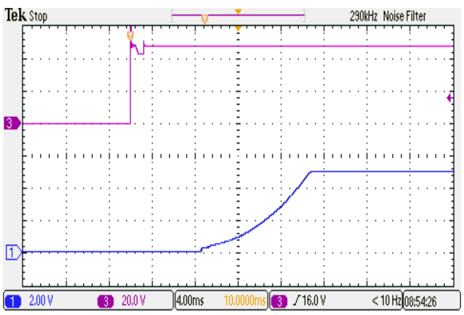
Efficiency Versus Input Voltage
Full Load



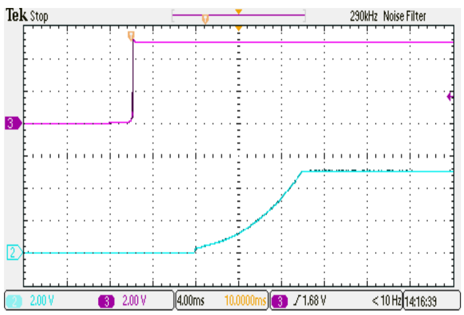
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



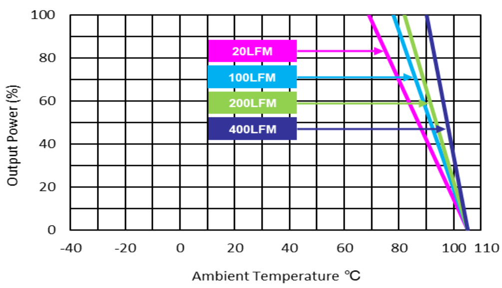
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



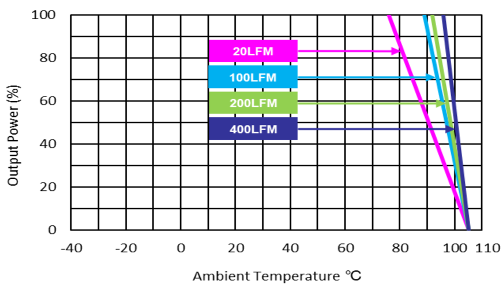
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



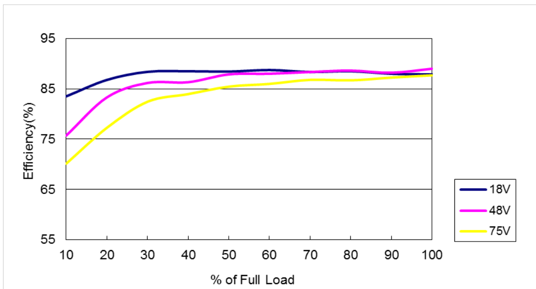
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



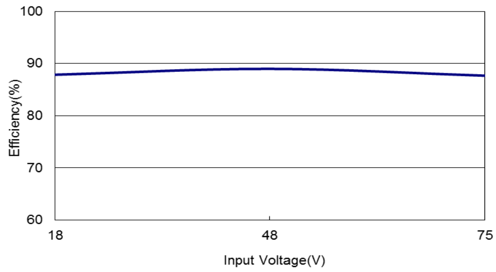
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

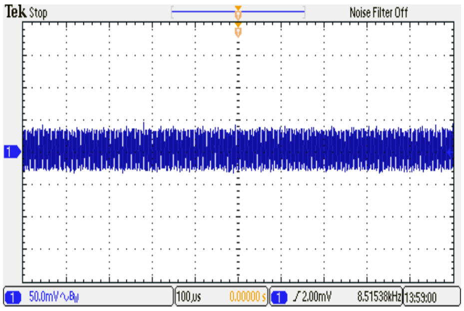
All test conditions are at 25℃ The figures are identical for MKZI20-48S12



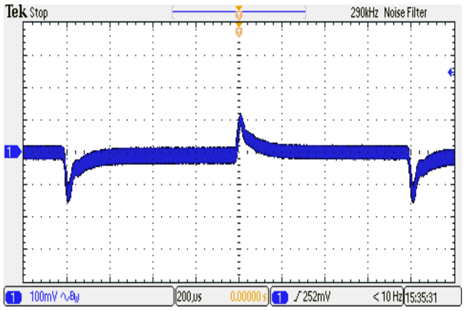
Efficiency Versus Output Current



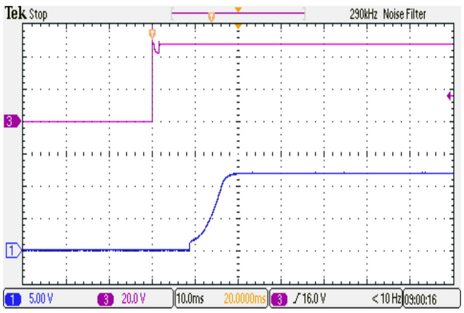
Efficiency Versus Input Voltage
Full Load



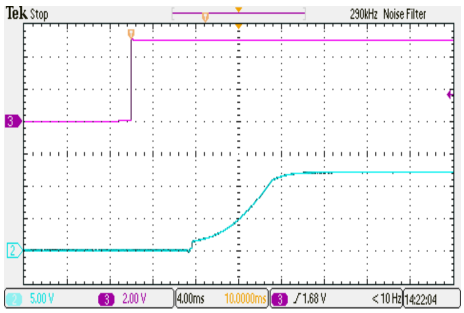
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



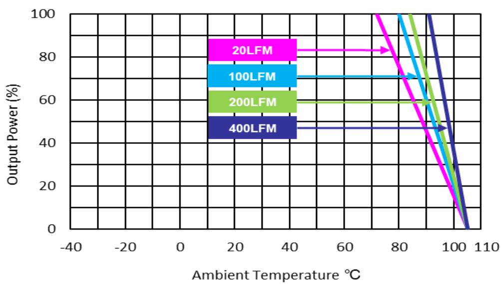
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



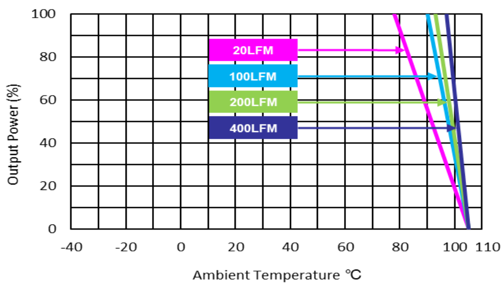
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



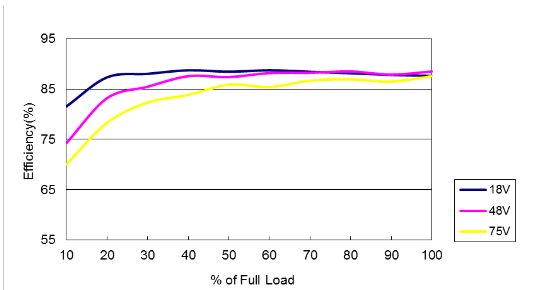
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



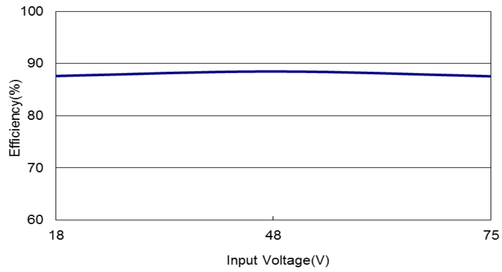
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

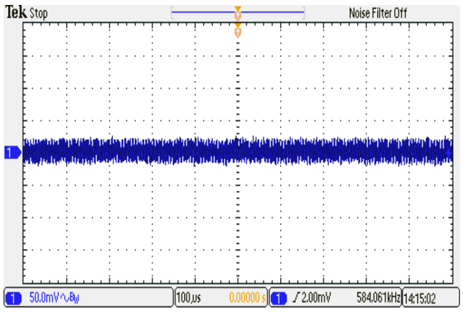
All test conditions are at 25℃ The figures are identical for MKZI20-48S15



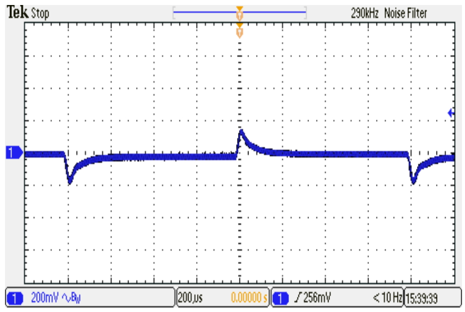
Efficiency Versus Output Current



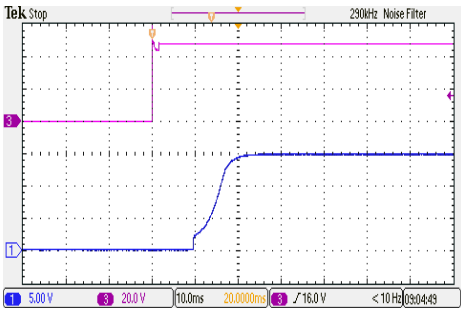
Efficiency Versus Input Voltage
Full Load



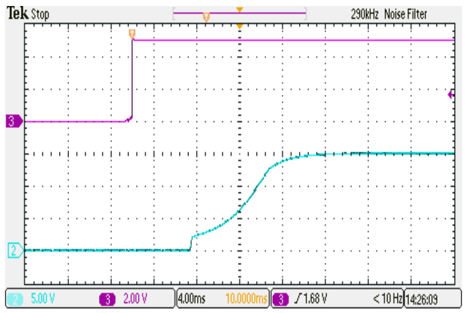
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



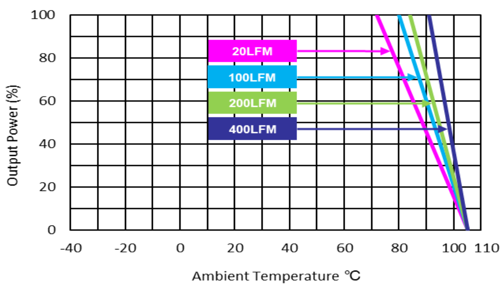
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



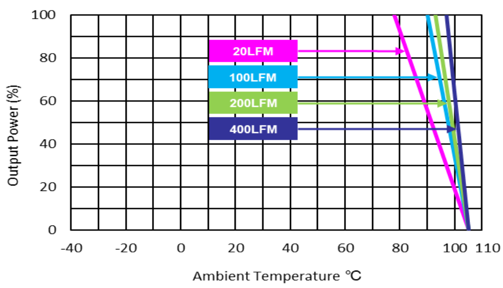
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



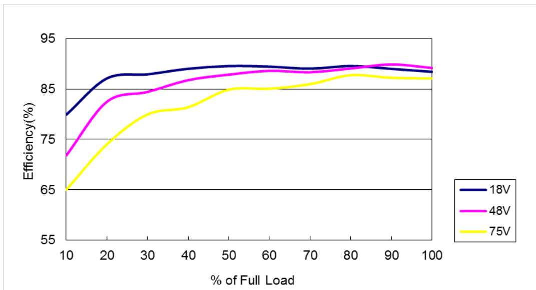
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



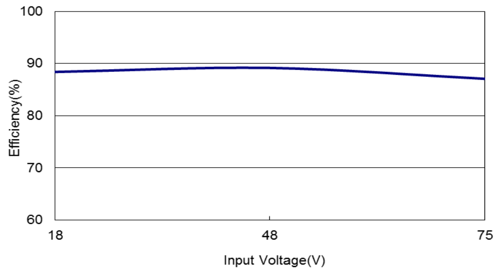
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

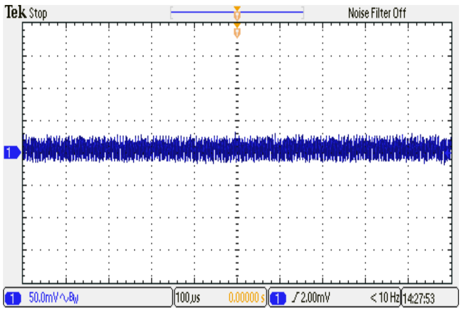
All test conditions are at 25℃ The figures are identical for MKZI20-48S24



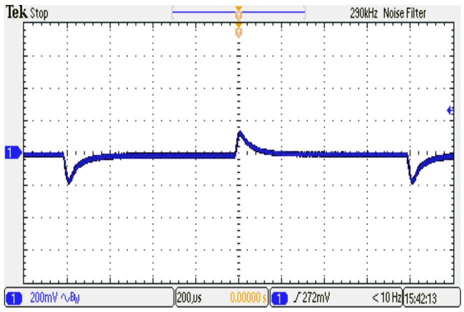
Efficiency Versus Output Current



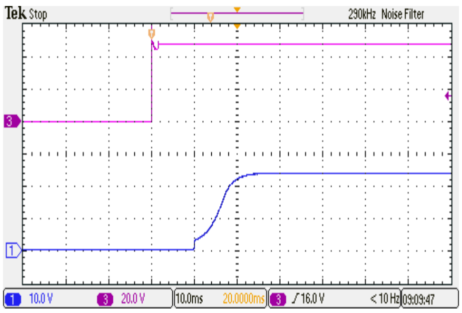
Efficiency Versus Input Voltage
Full Load



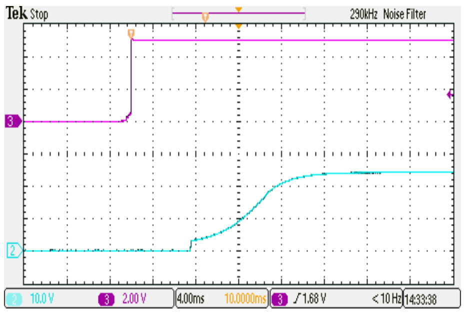
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



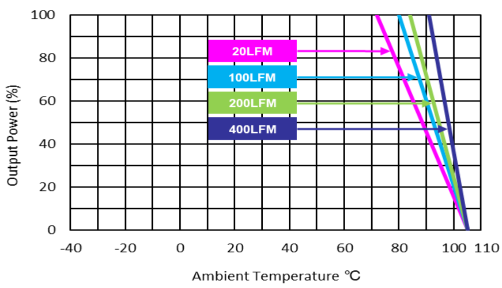
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



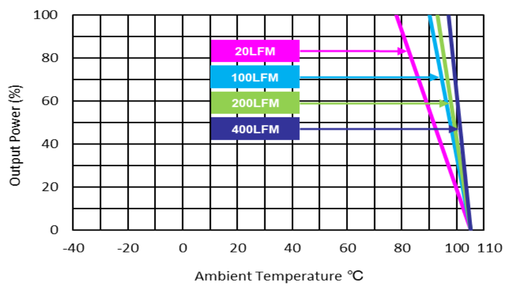
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



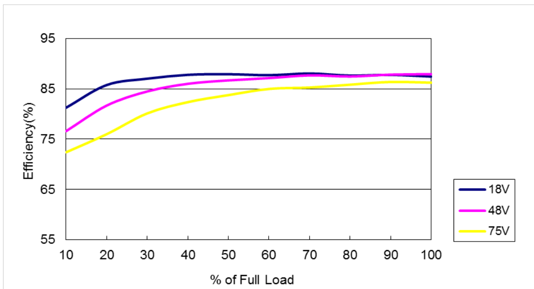
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



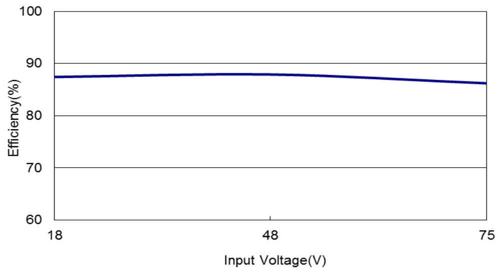
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

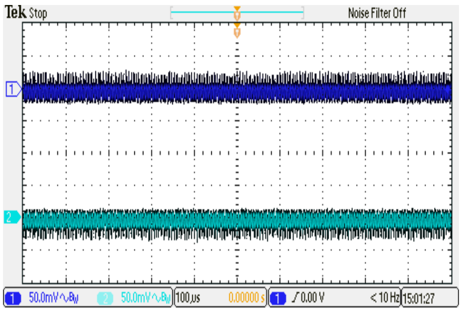
All test conditions are at 25℃ The figures are identical for MKZI20-48D12



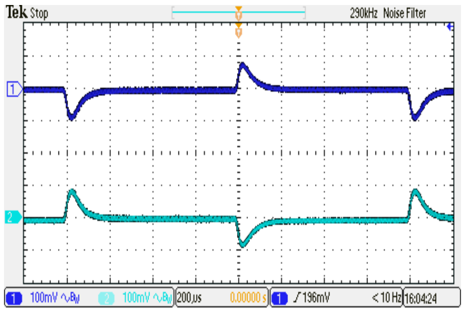
Efficiency Versus Output Current



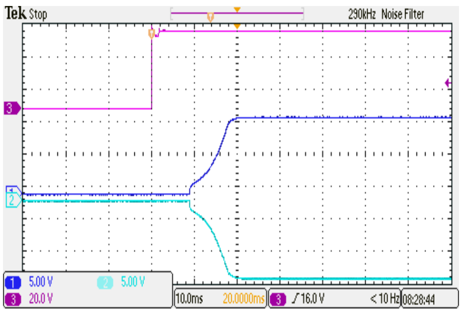
Efficiency Versus Input Voltage
Full Load



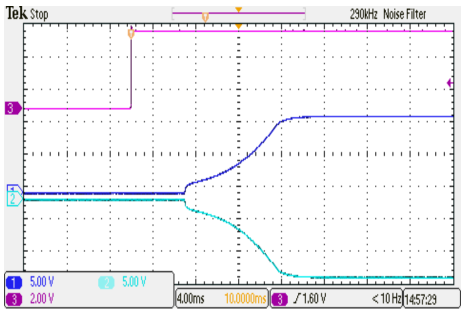
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



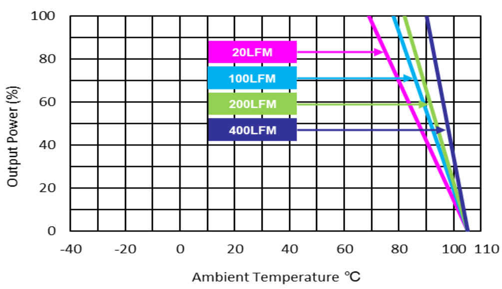
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



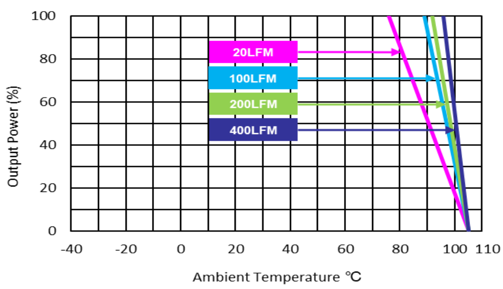
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



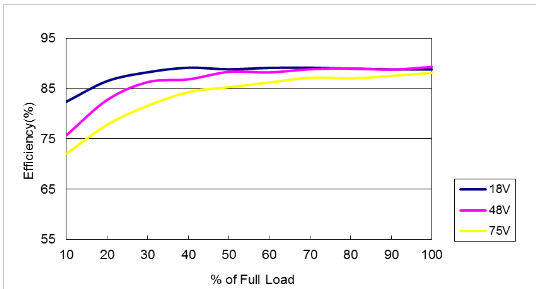
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



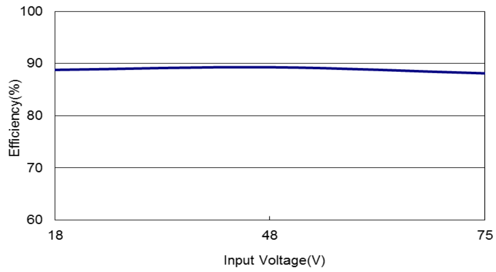
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

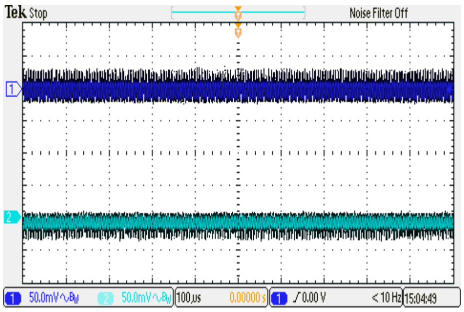
All test conditions are at 25℃ The figures are identical for MKZI20-48D15



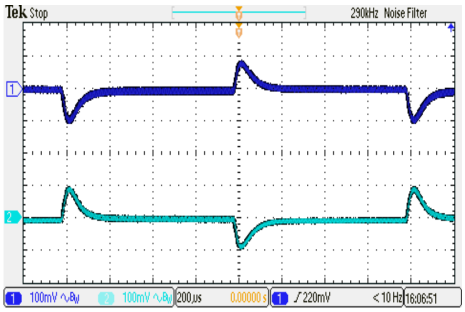
Efficiency Versus Output Current



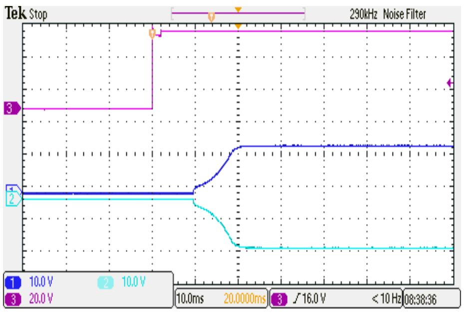
Efficiency Versus Input Voltage
Full Load



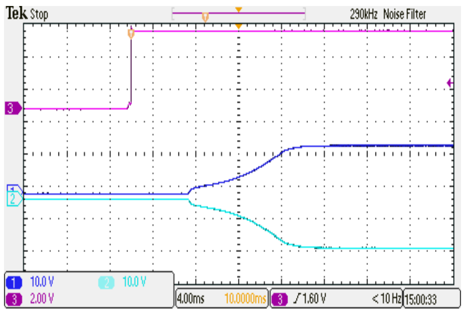
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



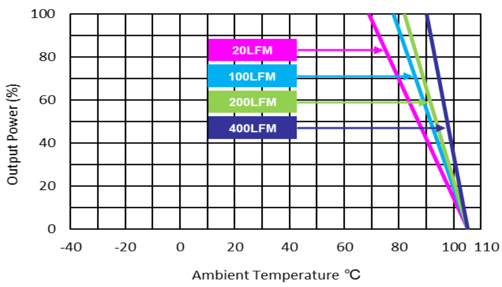
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



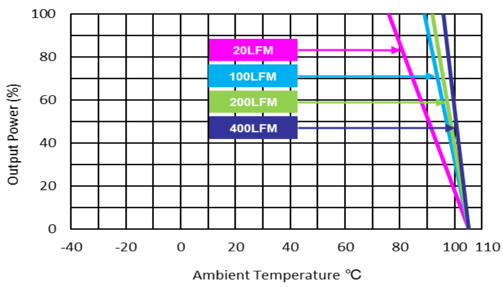
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



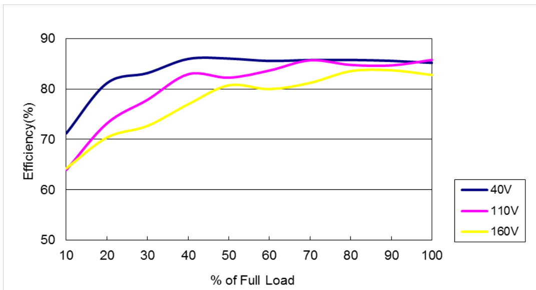
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



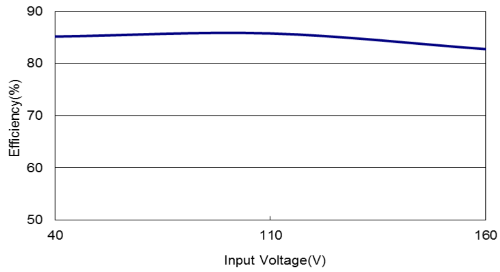
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

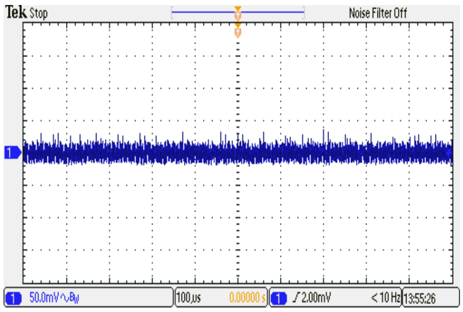
All test conditions are at 25℃ The figures are identical for MKZI20-110S05



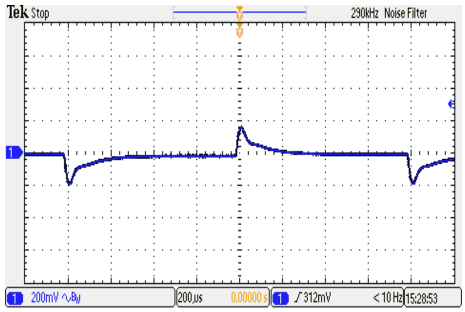
Efficiency Versus Output Current



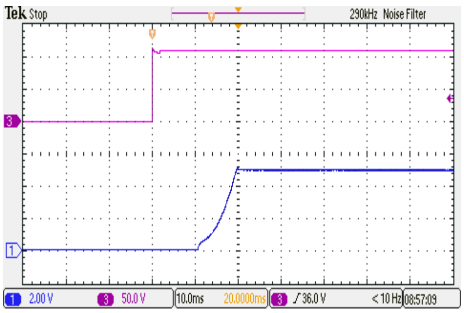
Efficiency Versus Input Voltage
Full Load



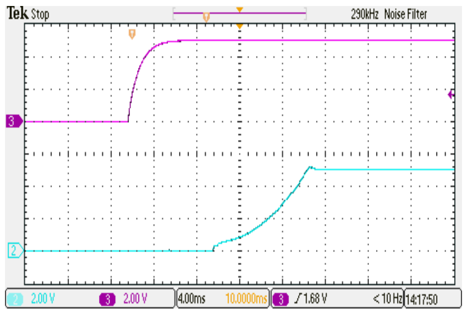
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



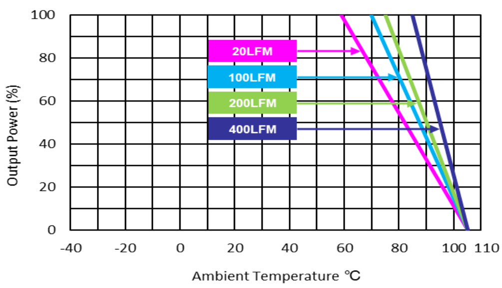
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



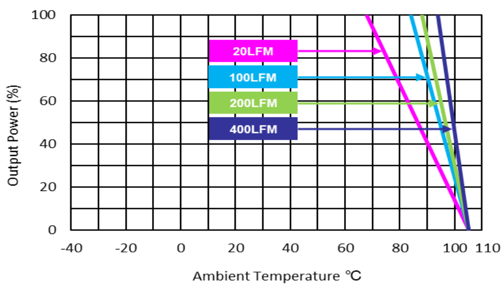
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



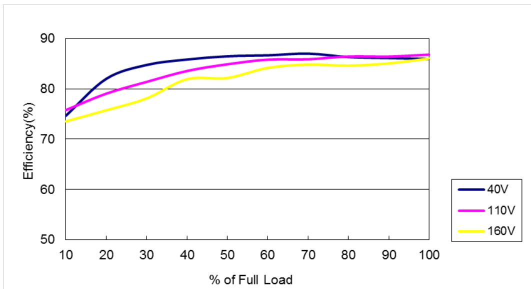
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



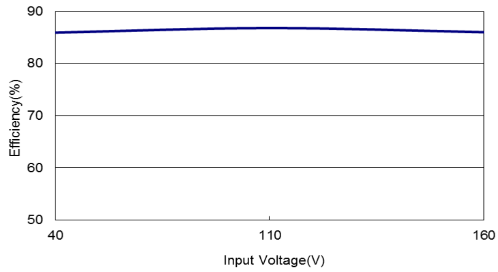
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

All test conditions are at 25℃ The figures are identical for MKZI20-110S12

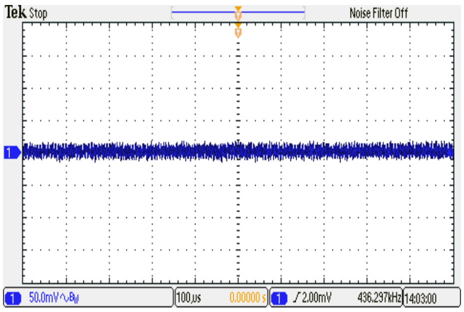


Efficiency Versus Output Current



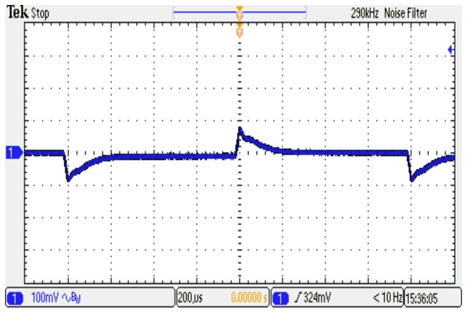
Efficiency Versus Input Voltage

Full Load



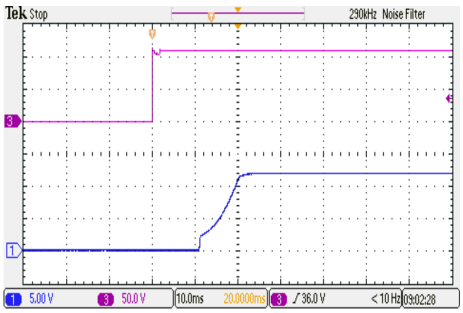
Typical Output Ripple and Noise

V_{in}=$V_{in\ nom}$; Full Load



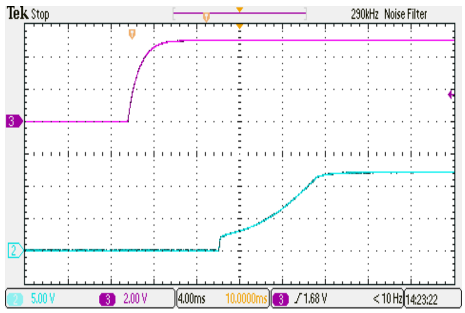
Transient Response to Dynamic Load Change

from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



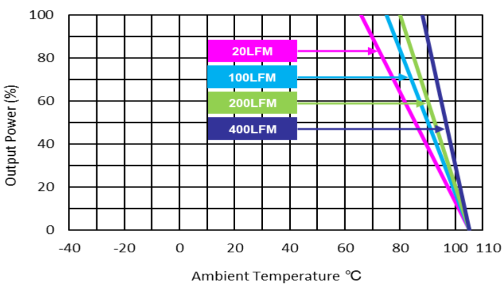
Typical Input Start-Up and Output Rise Characteristic

V_{in}=$V_{in\ nom}$; Full Load



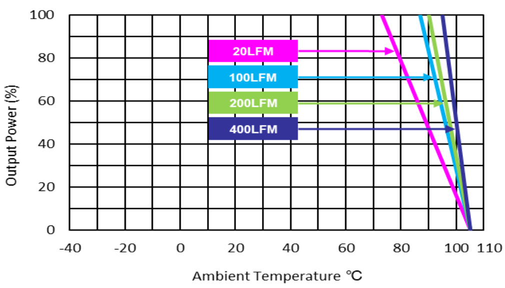
ON/OFF Voltage Start-Up and Output Rise Characteristic

V_{in}=$V_{in\ nom}$; Full Load



Derating Output Power Versus Ambient Temperature and Airflow

V_{in}=$V_{in\ nom}$ (without heatsink)

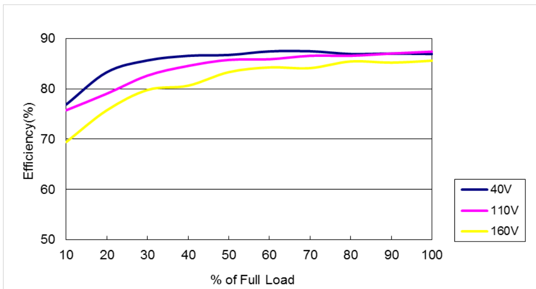


Derating Output Power Versus Ambient Temperature and Airflow

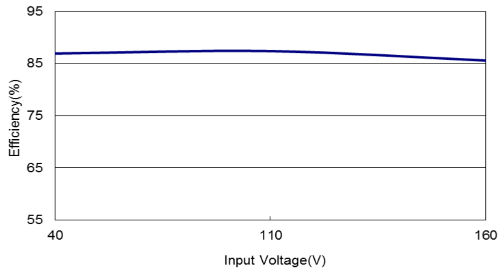
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

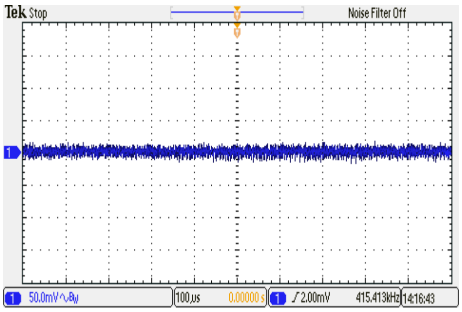
All test conditions are at 25℃ The figures are identical for MKZI20-110S15



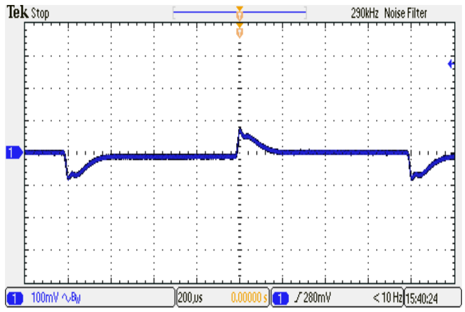
Efficiency Versus Output Current



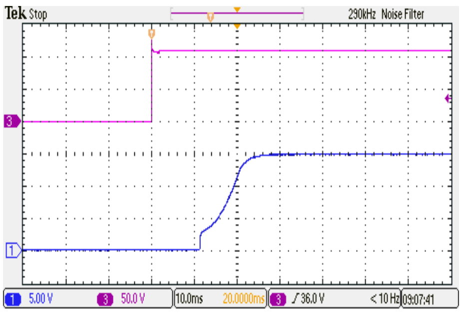
Efficiency Versus Input Voltage
Full Load



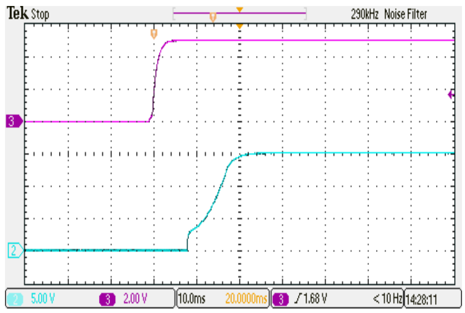
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



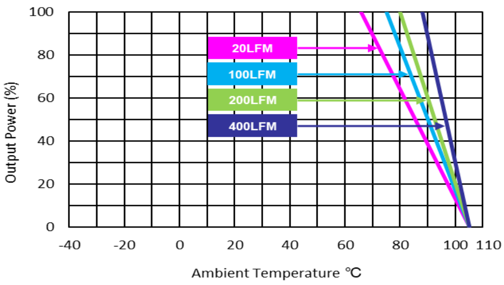
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



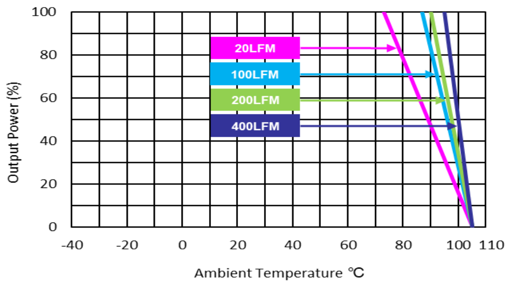
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



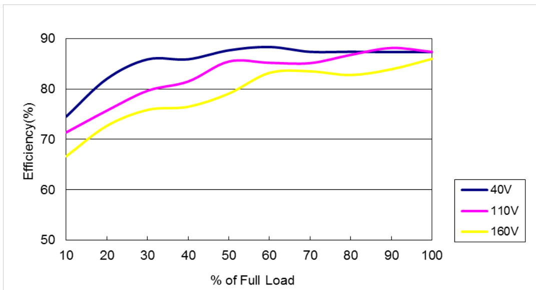
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (without heatsink)



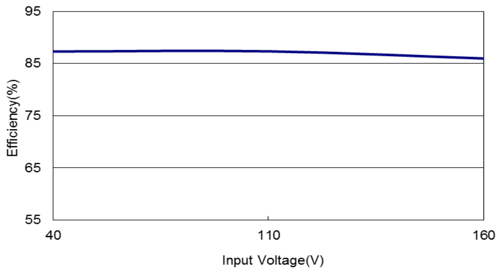
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$ (with heatsink)

Characteristic Curves

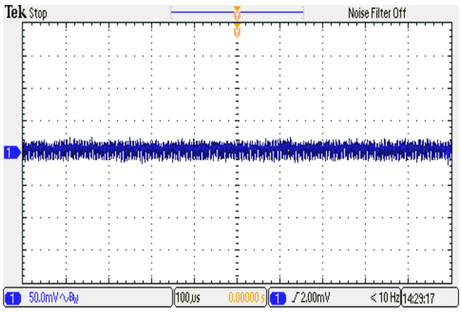
All test conditions are at 25℃ The figures are identical for MKZI20-110S24



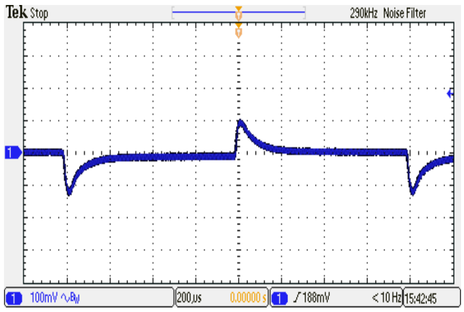
Efficiency Versus Output Current



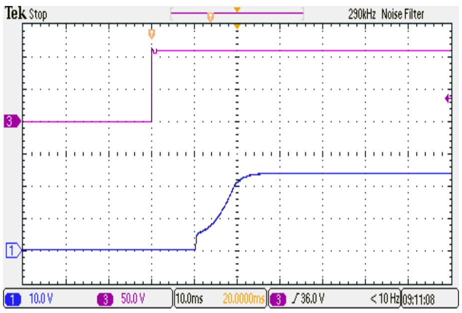
Efficiency Versus Input Voltage
Full Load



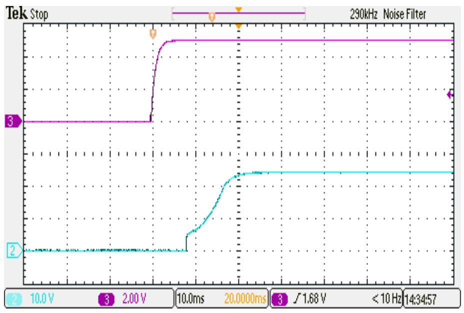
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



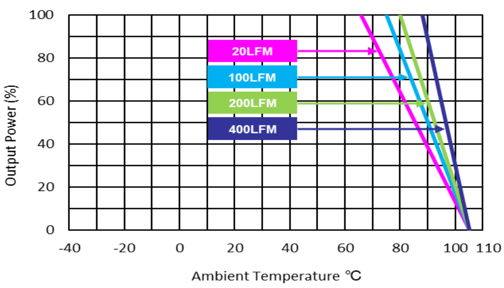
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



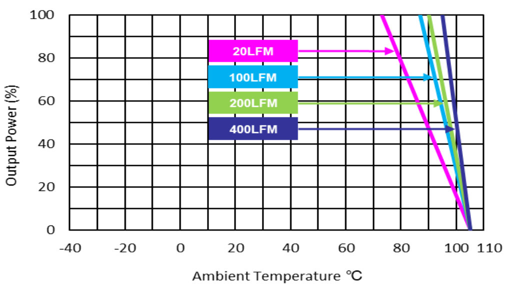
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



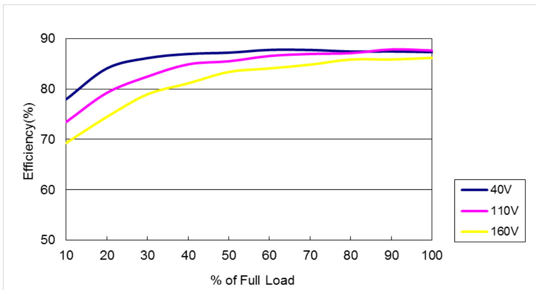
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



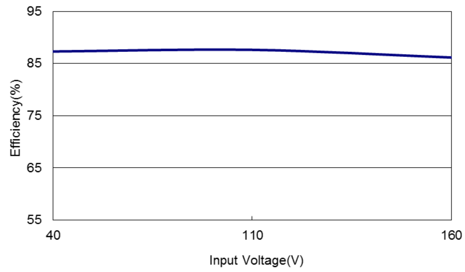
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

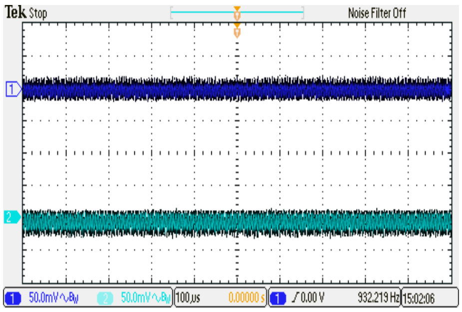
All test conditions are at 25℃ The figures are identical for MKZI20-110D12



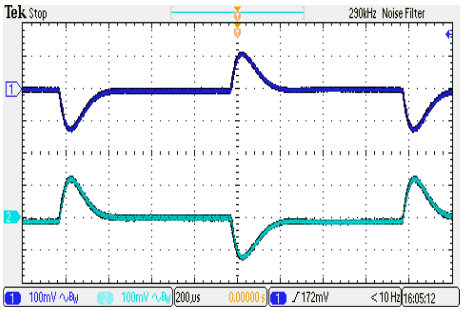
Efficiency Versus Output Current



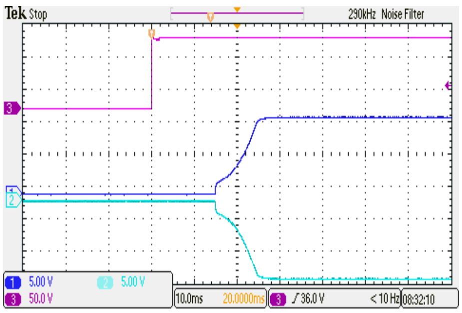
Efficiency Versus Input Voltage
Full Load



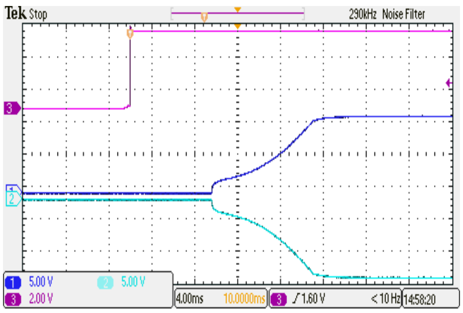
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



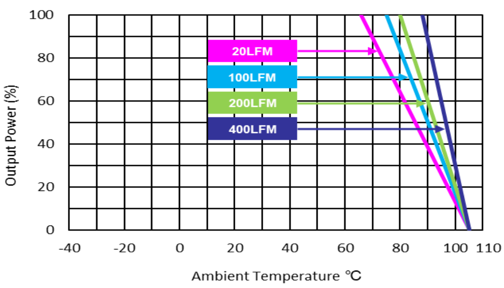
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



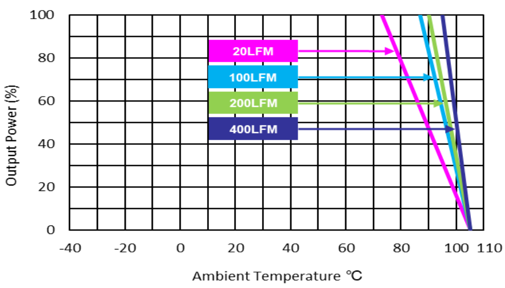
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



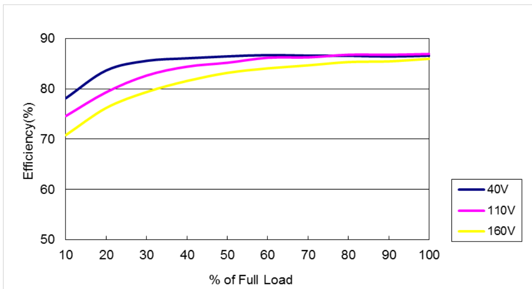
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



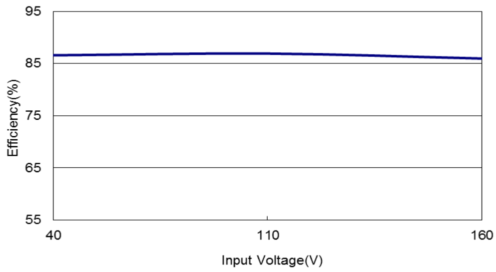
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Characteristic Curves

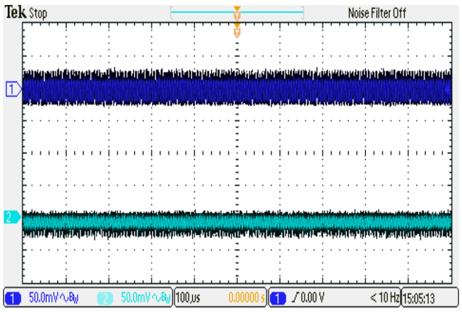
All test conditions are at 25℃ The figures are identical for MKZI20-110D15



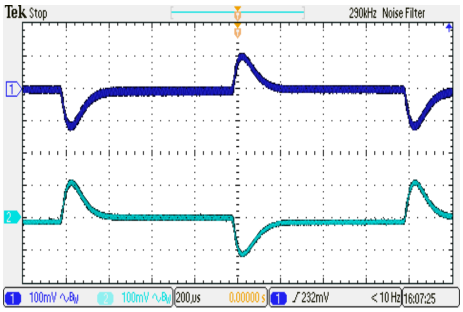
Efficiency Versus Output Current



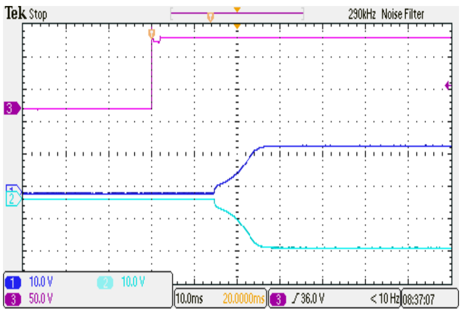
Efficiency Versus Input Voltage
Full Load



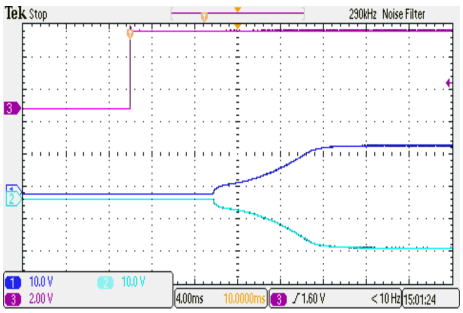
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



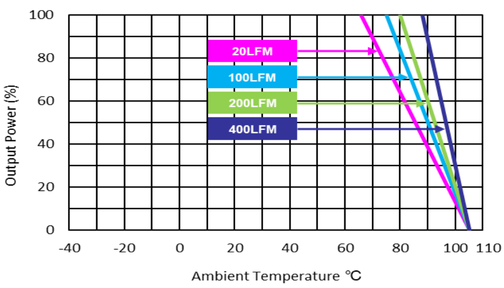
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



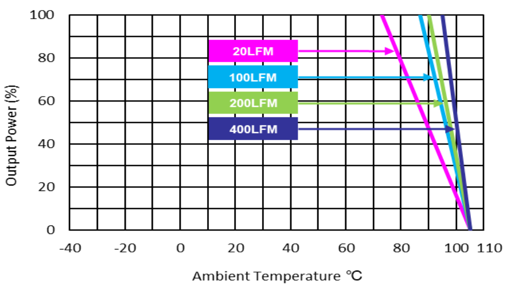
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



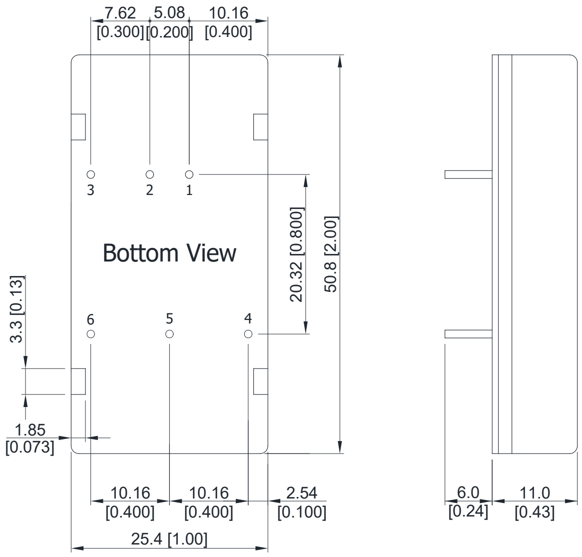
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (without heatsink)



Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$ (with heatsink)

Package Specifications

Mechanical Dimensions



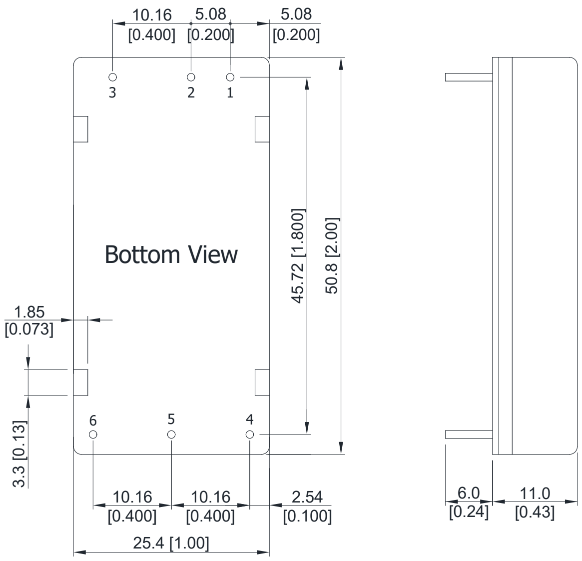
Pin Connections

Pin	Single Output	Dual Output	Diameter mm (inches)
1	+Vin	+Vin	Ø 1.0 [0.04]
2	-Vin	-Vin	Ø 1.0 [0.04]
3	Remote On/Off	Remote On/Off	Ø 1.0 [0.04]
4	+Vout	+Vout	Ø 1.0 [0.04]
5	Trim	Common	Ø 1.0 [0.04]
6	-Vout	-Vout	Ø 1.0 [0.04]

- All dimensions in mm (inches)
- Tolerance: X.X±0.75 (X.XX±0.03)
  X.XX±0.25 (X.XXX±0.01)
- Pin diameter tolerance: X.X±0.05 (X.XX±0.002)

Package Specifications with "A" Pinning (order code suffix A)

Mechanical Dimensions



Pin Connections

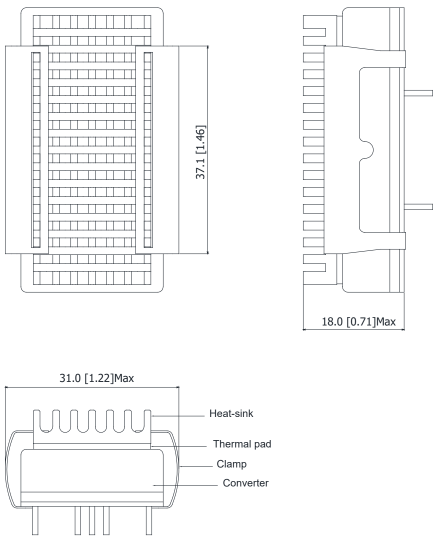
Pin	Single Output	Dual Output	Diameter mm (inches)
1	+Vin	+Vin	Ø 1.0 [0.04]
2	-Vin	-Vin	Ø 1.0 [0.04]
3	Remote On/Off	Remote On/Off	Ø 1.0 [0.04]
4	+Vout	+Vout	Ø 1.0 [0.04]
5	-Vout	Common	Ø 1.0 [0.04]
6	Trim	-Vout	Ø 1.0 [0.04]

- All dimensions in mm (inches)
- Tolerance: X.X±0.75 (X.XX±0.03)
  X.XX±0.25 (X.XXX±0.01)
- Pin diameter tolerance: X.X±0.05 (X.XX±0.002)

Physical Characteristics

Case Size	:	50.8x25.4x11.0 mm (2.0x1.0x0.43 inches)
Case Material	:	Metal With Non-Conductive Baseplate
Base Material	:	FR4 PCB (flammability to UL 94V-0 rated)
Insulated Frame Material	:	Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	:	Copper Alloy
Potting Material	:	Silicone (UL94-V0)
Weight	:	40.5g

Heatsink (Option, –HS)

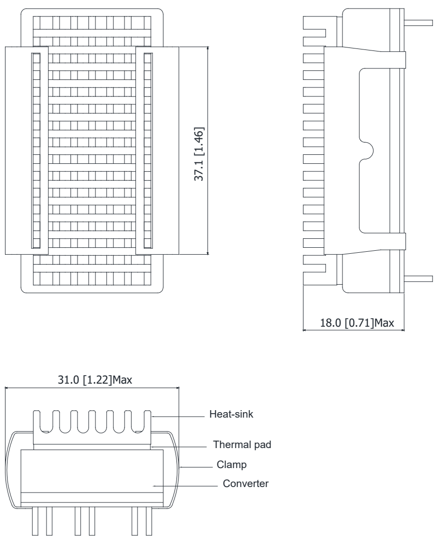


Physical Characteristics		
Heatsink Material	:	Aluminum
Finish	:	Black Anodized Coating
Weight	:	9g

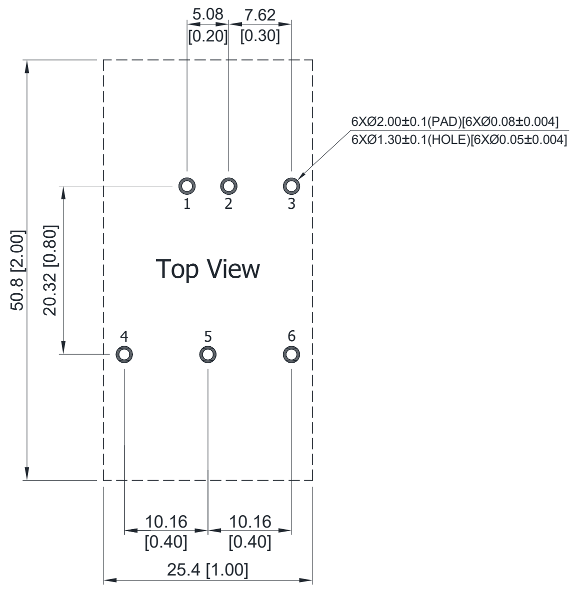
► The advantages of adding a heatsink are:

1. To improve heat dissipation and increase the stability and reliability of the DC-DC converters at high operating temperatures.
2. To increase operating temperature of the DC-DC converter, please refer to Derating Curve.

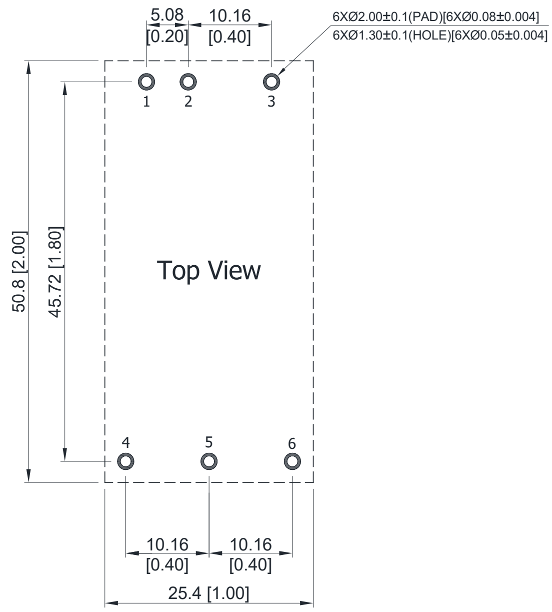
"A" Pinning Heatsink (Option, –HS)



Recommended Pad Layout for Single & Dual Output Converter

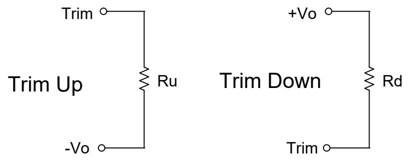


Recommended Pad Layout for Single & Dual Output Converter with "A" Pinning (order code suffix A)



External Output Trimming

Output can be externally trimmed by using the method shown below

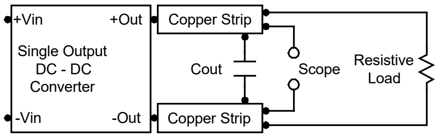


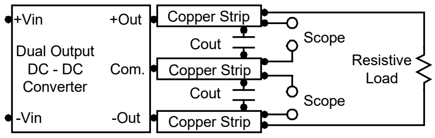
	MKZI20-XXS05		MKZI20-XXS12		MKZI20-XXS15		MKZI20-XXS24	
Trim Range (%)	Trim down (kΩ)	Trim up (kΩ)	Trim down (kΩ)	Trim up (kΩ)	Trim down (kΩ)	Trim up (kΩ)	Trim down (kΩ)	Trim up (kΩ)
1	156.81	119.77	419.81	344.74	602.92	482.88	598.97	486.83
2	70.69	53.70	187.68	154.37	269.91	215.89	267.93	217.87
3	41.99	31.67	110.30	90.92	158.91	126.89	157.59	128.21
4	27.64	20.66	71.61	59.19	103.41	82.40	102.42	83.38
5	19.03	14.05	48.40	40.15	70.10	55.70	69.31	56.49
6	13.29	9.65	32.93	27.46	47.90	37.90	47.25	38.56
7	9.18	6.50	21.87	18.39	32.05	25.18	31.48	25.75
8	6.11	4.14	13.58	11.59	20.15	15.65	19.66	16.14
9	3.72	2.31	7.13	6.31	10.90	8.23	10.46	8.67
10	1.80	0.84	1.98	2.07	3.50	2.30	3.11	2.69

Test Setup

Peak-to-Peak Output Noise Measurement Test

Use a 1μF ceramic capacitor and a 10μF tantalum capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.





Technical Notes

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 3) during a logic low is -100μA.

Overload Protection

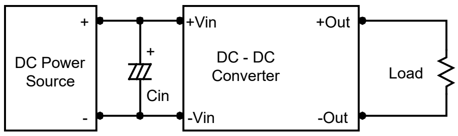
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage. The OVP level can be found in the output data.

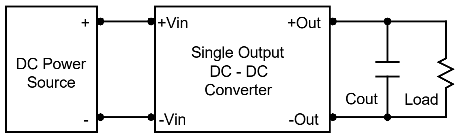
Input Source Impedance

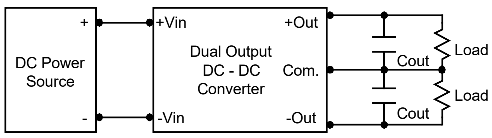
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 4.7μF for the 24V input devices, a 2.2μF for the 48V devices and a 1μF for the 110V devices.



Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 4.7μF capacitors at the output.



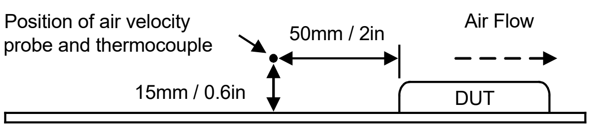


Maximum Capacitive Load

The MKZI20 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

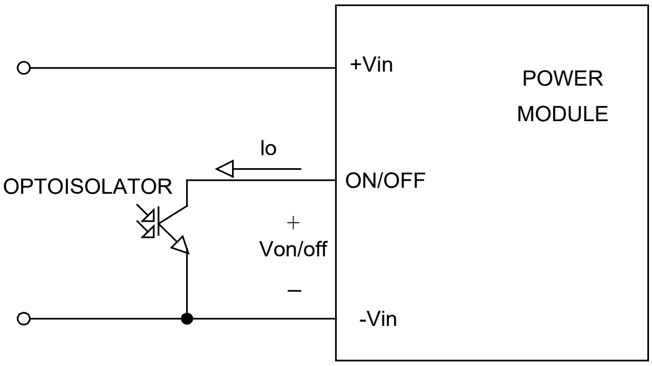
Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105°C. The derating curves are determined from measurements obtained in a test setup.

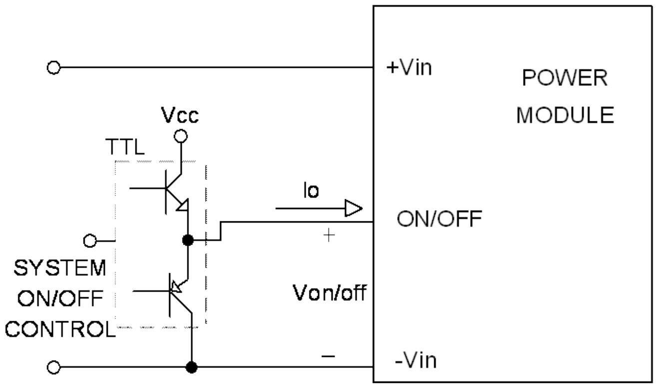


Remote On/Off Implementation

The positive logic remote ON/OFF control circuit is included. Turns the module ON during logic High on the ON/Off pin and turns OFF during logic Low. The ON/OFF input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please open circuit between on/off pin and -Vin pin to turn the module on.

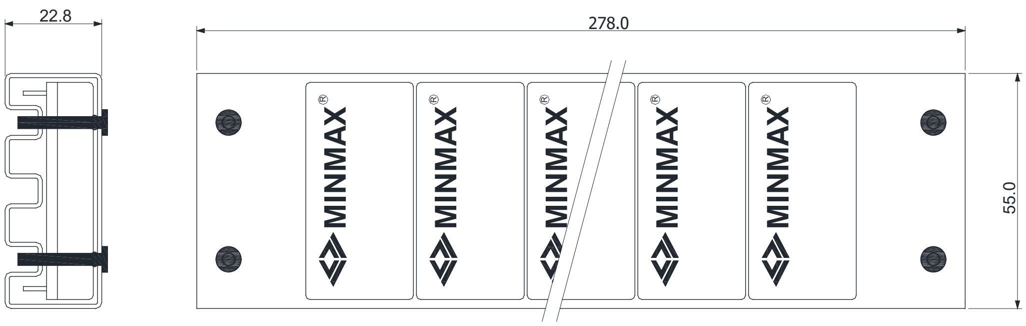


Isolated-Closure Remote ON/OFF



Level Control Using TTL Output

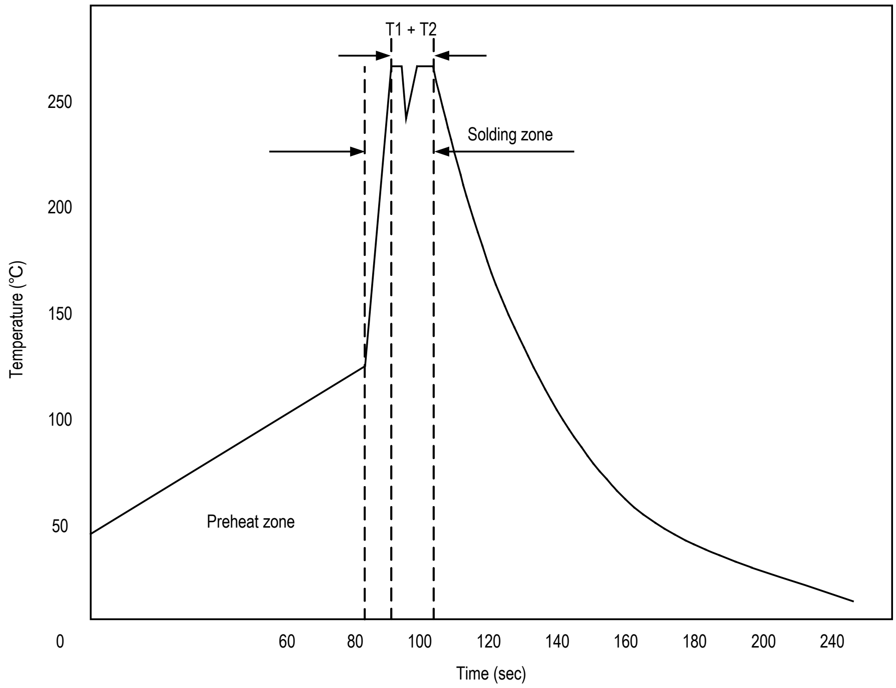
Packaging Information



Unit: mm
10 PCS per TUBE

Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat	Rise temp. speed：3°C/sec max.
zone	Preheat temp.：100~130°C
Actual	Peak temp.：250~260°C
heating	Peak time(T1+T2)：4~6 sec

Hand Welding Parameter

Reference Solder: Sn-Ag-Cu：Sn-Cu：Sn-Ag

Hand Welding: Soldering iron：Power 60W

Welding Time: 2~4 sec

Temp.: 380~400°C

Part Number Structure

M	K	ZI	20	-	24	S	05
	Package Type 2" X 1"	Ultra-wide 4:1 Input Voltage Range	Output Power 20 Watt		Input Voltage Range 24: 9 ~ 36 VDC 48: 18 ~ 75 VDC 110: 40 ~ 160 VDC	Output Quantity S: Single D: Dual	Output Voltage 05: 5 VDC 12: 12 VDC 15: 15 VDC 24: 24 VDC

MTBF and Reliability

The MTBF of MKZI20 series of DC-DC converters has been calculated using

MIL-HDBK 217F NOTICE2, Operating Temperature 25℃, Ground Benign.

Model	MTBF	Unit
MKZI20-24S05	873,800	Hours
MKZI20-24S12	1,180,000	
MKZI20-24S15	1,179,000	
MKZI20-24S24	1,179,000	
MKZI20-24D12	1,042,000	
MKZI20-24D15	1,041,000	
MKZI20-48S05	873,000	
MKZI20-48S12	1,290,000	
MKZI20-48S15	1,290,000	
MKZI20-48S24	1,289,000	
MKZI20-48D12	1,142,000	
MKZI20-48D15	1,142,000	
MKZI20-110S05	665,100	
MKZI20-110S12	927,700	
MKZI20-110S15	939,300	
MKZI20-110S24	1,051,000	
MKZI20-110D12	1,041,000	
MKZI20-110D15	1,041,000	